MAGNETIC DIPOLE INFLATION WITH CASCADED ARC AND APPLICATIONS TO MINI-MAGNETOSPHERIC PLASMA PROPULSION

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ABSTRACT

Mini-Magnetospheric Plasma Propulsion (M2P2) seeks to create a plasma-inflated magnetic bubble capable of intercepting significant thrust from the solar wind for the purposes of high speed, high efficiency spacecraft propulsion. Previous laboratory experiments into the M2P2 concept have primarily used helicon plasma sources to inflate the dipole magnetic field. The work presented here uses an alternative plasma source, the cascaded arc, in a geometry similar to that used in previous helicon experiments. Time resolved measurements of the equatorial plasma density have been conducted and the results are discussed. The equatorial plasma density transitions from an initially asymmetric configuration early in the shot to a quasi-symmetric configuration during plasma production, and then returns to an asymmetric configuration when the source is shut off. The exact reasons for these changes in configuration are unknown, but convection of the loaded flux tube is suspected. The diffusion time was found to be an order of magnitude longer than the Bohm diffusion time for the period of time after the plasma source was shut off. The data collected indicate the plasma has an electron temperature of approximately 11eV, an order of magnitude hotter than plasmas generated by cascaded arcs operating under different conditions. In addition, indirect evidence suggests that the plasma has a β of order unity in the source region.

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